A NOTE ON THE GROWTH HABIT OF FRINGED POLYGALA

JAMES V. LAFRANKIE, JR.

ABSTRACT

The green leaves and flowers of *Polygala paucifolia* occur along the terminal, upright portions of long thin rhizomes that grow out from a small perennial tuber. Each tuber sends out several new rhizomes annually. New tubers are produced at the scale leaf nodes of the horizontal portion of the rhizome through the multiplication of lateral buds and through secondary vascular growth. This mode of vegetative reproduction increases the longevity of a plant and spreads an individual laterally.

In this paper I describe the vegetative growth of *Polygala paucifolia* Willd. (Polygalaceae) emphasizing the development of the perennial, subterranean organs. Although these small tuberous structures are often included in herbarium material of *P. paucifolia*, a description of their ontogeny and role in the life history of the species is absent from systematic treatments of the genus (Wheelock, 1891; Miller, 1971).

There is little recent literature on the morphology and anatomy of the genus. Holm (1929) mentions the existence of what he inappropriately calls a "pseudo-rhizome", but he was unaware of its curious development. The following account is based on material excavated on several occasions during 1982 from natural populations growing in Harvard Forest, Petersham, Massachusetts, and from an oak woods near Bellows Falls, Vermont. I confirmed certain phenological observations by making repeat visits to marked plants. A survey of the herbaria of Harvard University and the New England Botanical Club failed to show any significant geographic variation in growth habit.

Polygala paucifolia blooms in Massachusetts during the latter part of May and the first two weeks of June, often forming conspicuous patches on the forest floor. A short vegetative axis, usually with basal cleistogamous flowers, supports 3-7 photosynthetic leaves and frequently terminates with a pair of chasmogamous flowers. Careful excavation reveals that this upright shoot is the end of a pale, thin (1.0-1.5 mm diameter) horizontal stem, resting 1–2 cm beneath the soil litter. This stem can be traced back 5–30 cm to a small (1–5 mm diameter), well rooted, tuberous organ from which several other horizontal stems radiate.

Along this horizontal stem occur scale leaves arranged in a spiral fashion, with internodes ranging from one to seven centimeters. Each scale leaf subtends an axillary bud that may be in one of four conditions: (1) inactive, (2) growing as a horizontal shoot, the parent axis then being branched, (3) growing as a short vertical vegetative shoot, (4) growing as a short vertical shoot terminating in a pair of cleistogamous flowers. Typically, the cleistogamous flowers are found on a lateral appendage near the base of the chasmogamous flowering stem. All four conditions are represented in Figure 1a.

A tuber is the source of the horizontal stems, but the critical feature of the growth habit is that the horizontal stems are a source of new tubers. These tubers develop at the scale leaf nodes over the course of several years, and three processes are involved: root initiation, meristem proliferation, and secondary vascular growth. The following account describes a typcial course of tuber development.

When a lateral bud grows out, one or two adventitious roots are initiated on the new stem immediately adjacent to the parent axis (Fig. 1b). There are no roots on the parent stem and no further roots will form at this node. Immediately above the adventitious roots, a pair of scale leaves and axillary buds are initiated, followed by a long internode separating them from subsequently formed photosynthetic leaves. The lateral shoot that bears these structures will live through the summer, fall, and possibly winter before dying back to a point just above the scale leaves. The buds in the axils of those scale leaves then grow out, and each in turn will form its own pair of basal scale leaves and axillary buds (Fig. 1c). Note that the plane of bud insertion is always perpendicular to that of the previous year. This process of shoot die back and basal bud proliferation is repeated annually and leads to a tuber (at this stage, really a condense sympodial branch system) with an increasing number of meristems (Fig. 1d). About the third year in its development, the tuber becomes independent of the parent axis which decays at the adjacent internodes. Continued meristem proliferation and secondary vascular growth in both roots and stems (Fig. 1e) leads to a mature tuber (Fig. 1f).

The tuber contributes toward the longevity of the individual by its own survival and through the potential it provides for the development of new tubers on the annual crop of runners. This growth

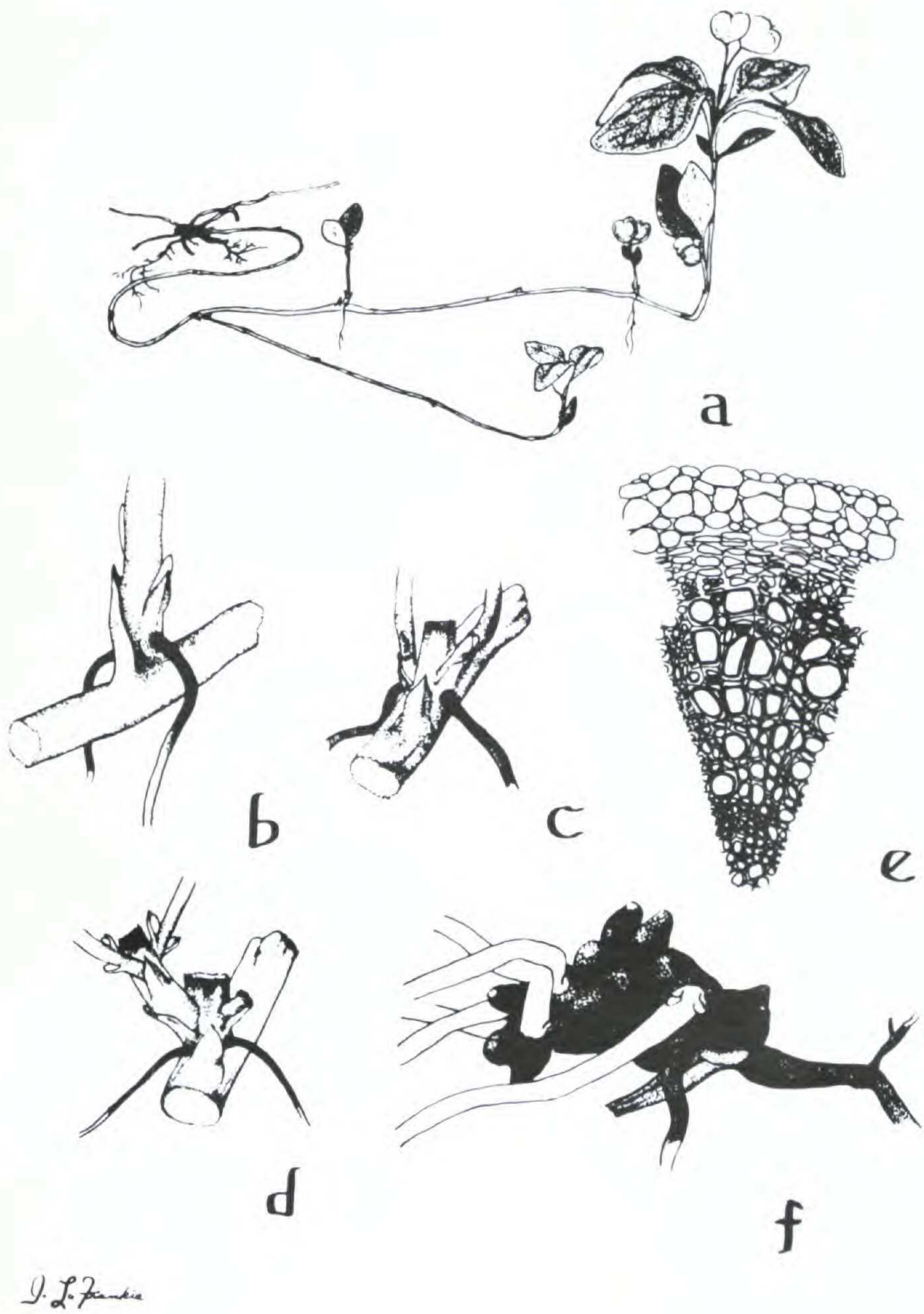

Figure 1. *Polygala paucifolia*: Early stages of tuber development. **a.** Habit sketch, 1/3 ×. **b.** First year; two roots and two basal buds are initiated. **c.** Second year; basal buds grow out initiating their own basal buds. **d.** Third year; basal bud proliferation continues, but here illustrated for only one branch and the buds slightly separated. **e.** Root, transverse section, 100 ×. **f.** Habit sketch of mature tuber, 3×.

habit has the added advantage of allowing for the lateral spread of a plant. The longevity of individual tubers is uncertain, though their importance in proliferation and perennation seems obvious. This provides a clue as to how certain unique populations of blue and white flowered plants have persisted in particular locations for over 75 years (Eaton, 1952).

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HARVARD FOREST
PETERSHAM, MA 01366